

abounds in Florida, where it may be found on nearly every kind of tree. We know of one plant growing on a low *Prunus Chicasa* only eight feet from the ground." Dr. J. S. Newberry¹² reports var. *pubescens* as being found on *Æsculus Californica*, at Benicia, California. Dr. J. Torrey¹³ states that var. *orbiculatum* was found on *Quercus Emoryi*, in New Mexico, and var. *pubescens* on *Q. agrifolia* in Southern California. In Bot. Mex. Bound. he reports var. *glabriusculum* as being found on *Algarobia glandulosa* along the Rio Grande. Dr. George Engelmann¹⁴ says of var. *macrophyllum* that it was found on soft woods, the Ash, Willow, Poplar, Sycamore and Sapindus, along the Gila and Bonita rivers; and of var. *villosum*, that it was found on hard woods, principally Oaks, in Oregon, California and Arizona, and in the mountains of Arizona on *Q. undulata*. I am informed by perfectly reliable authority that it is common on the Persimmon in the southernmost counties of Illinois. L. F. Ward informs me he has observed it on *Acer rubrum* in the Dismal Swamp.

Notes on the Flora of W. Dakota and E. Montana Adjacent to the Northern Pacific Railroad.* I.

BY JOHN B. LEIBERG.

While in the service of the Northern Pacific Railroad Company during the past year in the interest of tree culture, I had abundant opportunity to examine the interesting and, to some extent, peculiar flora of Western Dakota, and to a limited degree the eastern portion also, and the eastern part of Montana as far west as the Yellowstone river at Glendive, and to make large and full collections of the same. Copious and interesting notes were made respecting the botanical features of the region, and a few of the more prominent are here presented.

The climate of Eastern Dakota, in both rain-fall and temperature, does not appear to present any great variation from that of the prairie region of Western Minnesota, except, perhaps, a somewhat longer winter. The climate of the western portion is very different. The summer is very dry; showers are of rare occurrence, and the temperature varies excessively. Thus in the month of July the mercury rose to 115° Fahrenheit, and fell to 32°.

¹²Pacif. R. R. Rep. ¹³Pacif. R. R. Rep. ¹⁴Bot. Wheeler's Expd. 252.

*Read before the Minnesota Academy of Natural Sciences, March 4, 1884.

Such great variations can not fail to modify plant life to a very great extent. The hot, scorching winds that generally accompany the high temperatures quickly dry up all vegetation, except along the water-courses. The extreme dryness of these hot winds is remarkable. During the great heat which prevailed in the early part of July, I saw the grass on the prairie, which was green and fresh as prairie grass usually is, completely dried up and converted into hay within a period of two hours. As a consequence of this dry weather, we find no annuals in summer. They only appear during the spring while the ground is still moist. The perennials all have long root-stocks, which penetrate deeply into the ground and enable them to withstand the drouth effectually.

The surface of the country west of the Red river valley is more rolling than in Minnesota, and is found still more so as the Missouri river is approached. Numerous stony knolls and long ranges of rocky, pointed hills mark the ancient glacial moraines. The flora here shows plain indications of the proximity of the dry, treeless plains west of the Missouri, though at the same time the climate is humid enough to permit species of plants to grow and flourish, whose principal habitat is much farther eastward. Here and there alkaline pools appear with their peculiar plants, adding largely to the variety of the flora of this region. Many species are found whose home in the southwest is at a high elevation, proving that as we go north the increase in latitude compensates for a decrease in elevation.

Scattered over the drift hills in great abundance, and the first flower to appear in spring, is *Anemone patens*, L., var. *Nuttalliana*, Gray, attaining a luxuriance of growth never met with in Minnesota. After crossing the Missouri and the western boundary of the glacial drift, this plant wholly disappears. In the moist places of the prairies is found *Ranunculus glaberrimus*, Hook., and around alkaline ponds *R. Cymbalaria*, Pursh, the latter being very abundant west of the Missouri river. Another representative of this genus resembles *R. rhomboideus*, Goldie, but differs from that in its more erect and taller growth and much smaller flowers. It appears to be some undescribed species.

A *Draba*, probably *D. nemorosa*, L., is quite plentiful. Early in the spring, and flowering until late in the summer, we find *Vesicaria Ludoviciana*, DC. *Erysimum asperum*, DC., var. *Arkansanum*, Nutt., is abundant as we proceed westward, becoming a very conspicuous plant. Around the alkaline ponds grows a *Nasturtium*, near *N. sinuatum*, Nutt. It may prove to be only a variety of this species.

Cleome integrifolia, Torr. & Gr., which is found here and there in Minnesota as an introduced plant, is first met with in its indigenous state in Pyramid Park, near the Little Missouri river. There also, and nowhere else in the territory under consideration, *Cleome lutea*, Hook., was observed. *Polanisia graveolens*, Raf., was frequently noticed along the water-courses, differing somewhat from its character in Minnesota, in having a more clammy pubescence and longer and more turgid pods.

Viola Nuttallii, Pursh, was met with abundantly, but does not extend to any great distance west of the Missouri river, and was not observed east of Jamestown. *Viola cucullata*, Ait., was not rare in the region covered by the drift, but was confined to the borders of the numerous small ponds.

A *Cerastium* and two species of *Arenaria*, not determined, were very common. One of the *Arenarias* was met with only on the top of the buttes west of the Missouri, forming dense tufts, the short stems closely covered with small rigid leaves, giving it a spiny appearance.

A rather common and showy plant was *Malvastrum coccineum*, Gray, the only one of the *Malvaceæ* seen.

Two species of *Linum*, *L. rigidum*, Pursh, and *L. perenne*, L., were found. The latter grows very rank, with showy blue flowers, often more than an inch in diameter. The seed-vessels were observed later in the season and were found to be nearly as large as in the cultivated flax (*L. usitatissimum*, L.), with seeds about half as large, of a shining dark brown color, and apparently containing a considerable proportion of oil. The question arises, whether this wild flax could be improved by cultivation so as to equal in fiber, if not in oil, the *L. usitatissimum*. It is well worth experiment to determine these points, more especially as it is a perennial, while the cultivated flax is an annual.

Polygala verticillata, L., and another species, of which no published description could be found, were frequently collected west of the Missouri, extending into Montana.

As might be expected, the *Leguminosæ* were well represented, but a lack of authorities and published descriptions prevented full and complete determinations of the many interesting species collected. Fourteen species of *Astragalus* were observed, among them *A. simplicifolius*, Gray, and *A. triflorus*, Gray. The former was observed only in Montana, on the hills between McClennan and Hodges stations on the Northern Pacific Railroad. *Psoralea argophylla*, Pursh, *P. esculenta* Pursh, and *P. lanceolata*, Pursh, were noted. The latter possesses the peculiarity of forming at

maturity a perfect joint on the stem near the ground. A light wind will then cause the plant to break off and go rolling along in the same manner as happens with *Amarantus albus*, L. (commonly called "tumble-weed"), on the prairies of Minnesota. *Psoralea argophylla* and *esculenta* also break off near the ground, but do not appear to form a distinct joint. The separation in these species is effected by means of a constriction on the stem, which cuts off, as it were, the nourishment from the root, and causes the stock to shrivel at that point, when the least touch or gust of wind releases the plant. On the hills near Mandan, and in no other place along the route, *Petalostemon macrostachyus*, Torr., was collected. Here also *P. villosus*, Nutt., was quite abundant. *Amorpha fruticosa*, L., and *A. canescens*, Nutt., were both well represented, but a little farther westward they were largely replaced by *A. microphylla*, Pursh. *Oxytropis*, *Desmodium*, *Vicia*, *Lathyrus* and *Hosackia* were found in abundance throughout the territory. *Lupinus perennis*, L., was met in the valley of the Green river; also an apparently undescribed species of this genus was collected.

Eleven species of *Potentilla* were collected, among them *P. Pennsylvanica*, L., and *P. fruticosa*, L., the latter nowhere except in Pyramid Park. Only one species of *Prunus* was seen west of the Missouri river, namely, *P. pumila*, L. Growing abundantly on the rocky buttes was *Chamaerhodos erecta*, Bunge. So far as I know, this plant has not before been referred to this region. Our most common species of strawberry (*Fragaria Virginiana*, Duchesne) abounds east of the Missouri, but is very infrequent farther west. The hot dry weather prevailing during June and July doubtless proves unsuitable for its growth.

A gooseberry (*Ribes*) near *R. Cynosbati*, L., of a low bushy form, thickly armed with long stout prickles, grows on the summit of the dry baked clay hills of Western Dakota and Eastern Montana. Although growing in these extremely dry localities, it was heavily loaded in the month of July with large ripe juicy fruit, possessing a sweet and agreeable taste. Aside from scattered patches of *Shepherdia*, this was the only native edible wild fruit that was observed along the route after crossing the Missouri.

Hippuris vulgaris, L., rare in Minnesota, is plentiful in every little stream west of the Missouri, provided it is not alkaline and contains water sufficient to prevent complete evaporation during the dry season.

Of the *Onagraceæ*, *Epilobium palustre*, L., and *E. molle*, Torr.,

were sparingly found; more common were *Enothera caespitosa*, Nutt., and *E. albicaulis*, Nutt., the latter extending as far as to Muskoda station east of the Red river. Much more rare was *E. Missouriensis*, Sims. *Gaura coccinea*, Nutt., was very abundant.

Three species of *Cactaceæ*, *Mamillaria vivipara*, Haw., *Opuntia Missouriensis*, DC., and *O. Rafinesquii*, Engelm., were plentiful. *O. Missouriensis* was first observed, in going westward, on the hills around Mandan.

The *Umbelliferae* were mostly represented by species of *Peucedanum*, *Cymopterus* and *Musenium*. Of these only one, *Peucedanum nudicaule*, Nutt., extends as far east as Minnesota.

On the Formation of Starch in Leaves.

In a recent communication to the *Arbeiten des Botanisches Institut*, in Wurtzburg (Bd. III), Prof. Sachs gives the results of his work during the past summer in connection with the above subject. The investigations were made with the object of determining the formation and disappearance of starch in the leaves of plants growing in the open, and under normal conditions of vegetation, and were carried on chiefly during the months of June, July and August on a large number of Dicotyledons from various families. Some twenty-two years ago Prof. Sachs showed that the presence of starch in chlorophyll grains could readily be detected by means of the now well-known iodine test, a modification of which was employed in these researches.

If fresh, green leaves are plunged in boiling water for ten minutes or so, certain soluble substances are extracted, but the starch and coloring matter of the chlorophyll grains remain in the still unbroken cells of the mesophyll. A short immersion in alcohol now removes the green coloring matter and certain bodies soluble in alcohol, leaving the starch behind in the colorless tissue. The presence of acids affects the degree of whiteness of the decolorized leaf; and the decolorization proceeds more rapidly in sunlight or warm alcohol than in the dark and cold. Leaves of *Tropaeolum* may be rendered completely white, like writing paper, in two or three minutes.

If the decolorized leaf be now placed in a strong solution of iodine in alcohol, the presence or absence of starch may be demonstrated in a few minutes. If no starch is present, the cellular tissue simply presents the well-known yellow color; if a large quantity of starch exists in the cells, the tissue appears blue black,